



UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua

Sidang Akademik 1996/97

April 1997

EBB 216/2 - KAWALAN MUTU

Masa : [2 jam]

Arahan Kepada Calon :

Kertas soalan ini mengandungi **LIMA BELAS (15)** muka surat bercetak dan **SEPULUH (10)** muka surat **LAMPIRAN**.

Kertas soalan ini mempunyai **ENAM (6)** soalan.

Jawab **EMPAT (4)** soalan sahaja **DUA (2)** soalan dari **BAHAGIAN A** dan **DUA (2)** soalan dari **BAHAGIAN B**.

Mulakan jawapan anda bagi setiap soalan pada muka surat yang baru.

Semua soalan mesti dijawab dalam Bahasa Malaysia ataupun maksimum **2 (DUA)** soalan dari **BAHAGIAN B** boleh dijawab dalam Bahasa Inggeris.

...2/-

BAHAGIAN A
SECTION A

1. (a) Manakah yang terbaik di antara pelan pensampelan tunggal, dubel dan berganda? Berikan penjelasan anda menggunakan contoh yang sesuai.

Between single, double and multiple sampling plans which one is the best?

Give your explanation with a suitable example.

(30 markah)

- (b) (i) Anda akan melaksanakan peraturan ANSI/ASQC Z1.4 dalam tatacara kawalan mutu untuk suatu proses penghasilan barangan yang mempunyai saiz lot 2000. Paras mutu boleh terima 2.5% telah dipilih. Pensampelan tunggal dilakukan berdasarkan pemeriksaan umum paras III. Operasi dijalankan menggunakan pemeriksaan normal dan didapati satu sampel dari lot pertama mengandungi 6 unit taklulus. Berdasarkan maklumat ini, apakah tindakan yang anda akan lakukan?

You are to implement ANSI/ASQC Z1.4 in a quality control procedure for a production process that has lots of size 2000. An acceptable quality level of 2.5% is selected. Single sampling is to be used under general inspection level III. Operating under rules for normal inspection, a sample from the first lot contain 6 nonconforming units. What action(s) should be taken?

...3/-

- (ii) Untuk proses yang dijelaskan di Bahagian (b)(i) di atas, sekiranya telah banyak lot yang diproses dan disebabkan oleh mutunya yang baik, maka pemeriksaan dikurangkan (reduced inspection) telah dilakukan. Dalam pelan pensampelan ini, satu sampel telah di ambil dan didapati mengandungi 5 unit taklulus. Dalam keadaan seperti ini apakah tindakan yang anda akan lakukan?

For the process described in (b(i)), suppose that many lots have been processed and, because of their good quality, reduced inspection has been instituted. Under this sampling plan, a sample is taken and contains 5 nonconforming units. What action(s) should be taken?

- (iii) Untuk proses yang dijelaskan di Bahagian (b)(i) di atas, sekiranya telah banyak lot yang dilakukan proses pensampelan dan oleh kerana wujudnya dua lot yang berturutan memberikan keputusan yang tidak boleh diterima, maka pemeriksaan secara diperketat (tightened inspection) telah dilakukan. Berdasarkan kepada maklumat ini bilakah agaknya pemeriksaan normal boleh dilakukan semula?

For the process described in (b(i)), suppose that many lots have been sampled, and since the last two consecutive lots have been rejected, a switch has been made to tightened inspection. When can the normal inspection be re-instituted?

(70 markah)

...4/-

2. (a) Apakah yang dimaksudkan dengan AOQL (Purata Had Mutu Keluaran)?

What is the Average Outgoing Quality Limit (AOQL)?

(20 markah)

- (b) Apakah yang dimaksudkan dengan ATI (Purata Pemeriksaan Total)?

What is the Average Total Inspection (ATI)?

(20 markah)

- (c) Kita sedang menimbangkan untuk membeli beberapa buah almari. Apabila kita tanya pihak pengeluar berkenaan pecahan proses taklulus (p), kita telah diberitahu bahawa firma berkenaan menggunakan pemeriksaan penulinan dengan nilai $ATI = 300$, $n = 100$ dan $c = 3$. Tentukan nilai p daripada maklumat yang diberikan berdasarkan saiz lot, $N = 4000$ buah.

We are considering the purchase of some widgets. When we ask the manufacturer about the process fraction nonconforming (p), we are told that the firm uses rectifying inspection with $ATI = 300$, $n = 100$, and $c = 3$. Determine the value of p from that information and from the fact that the lot sizes are $N = 4000$.

(60 markah)

...5/-

3. (a) Berikan penjelasan ringkas mengenai kepentingan sistem ISO9000 kepada industri pengeluaran dan bagaimanakah ianya berkaitan dengan kepentingan pihak pengguna.

Write and briefly explain about the importance of the ISO 9000 series to any of the manufacturing industry and how it is related to the consumers interest.

(40 markah)

- (b) Bagaimanakah Pensampelan Penerimaan boleh memberi manfaat kepada kedua-dua pihak pengilang dan pengguna?

How Acceptance Sampling could benefit both the manufacturers and consumers?

(30 markah)

- (c) Jelaskan dengan ringkas mengenai keboleh harapan dan bagaimanakah ianya boleh dicapai?

Explain briefly about reliability and how it can be achieved?

(30 markah)

...6/-

BAHAGIAN B

SECTION B

4. (a) Bilangan zarah-zarah α yang disepaikan daripada suatu sumber radioaktif merupakan peristiwa rambang dalam sesuatu tempoh. Bilangan penyepaian untuk 2608 sela masa berturutan dalam tempoh yang ditetapkan telah diperolehi dan keputusannya diberikan dalam Jadual 4a. Padankan suatu Taburan Poisson dan bandingkan ulangan-ulangan yang dilakukan secara perkiraan dan yang diukur.

Bincangkan sama ada suatu taburan normal boleh digunakan untuk memadankan data yang diberikan di atas.

Jadual 4a: Bilangan penyepaian zarah α dari suatu sumber radioaktif

Bil. Penyepaian	Ulangan
0	57
1	203
2	383
3	525
4	532
5	408
6	273
7	139
8	45
9	27
10	10
11	4
12	2

The number of α particles emitted from a radio active source are random events in time. The number of emissions during 2608 successive intervals of fixed duration were marked and the results are given in table 4a. Fit a Poisson Distribution and compare the calculated and measured frequencies.

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Discuss whether a normal distribution can be used for fitting the above data.

Table 4a The number of emissions from a radioactive sources

<i>No. of emissions</i>	<i>Frequency</i>
0	57
1	203
2	383
3	525
4	532
5	408
6	273
7	139
8	45
9	27
10	10
11	4
12	2

(50 markah)

- (b). Kekuatan untuk memutuskan wayar-wayar keluli nirkarat yang berdiameter tertentu telah diukur dan keputusannya diberikan di dalam Jadual 4b. Data yang diperolehi boleh dianggap sebagai berkeadaan taburan normal tanpa mengetahui nilai min dan varian.
- (i) Dapatkan nilai anggaran terbaik untuk min dan sisihan piawai untuk kekuatan memutuskan wayar berkenaan.

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- (ii) Dapatkan nisbah nilai-nilai min dan varian pada paras keyakinan 95%. Jadual-jadual keberangkalian yang disediakan boleh digunakan.

Jadual 4b: Ukuran kekuatan tegangan wayar keluli nirkarat

Spesimen	Daya (Kg)
1	48.89
2	52.07
3	49.29
4	51.66
5	52.16
6	49.72
7	48.00
8	49.96
9	49.20
10	48.10
11	47.90
12	46.94
13	51.76
14	50.75
15	49.86
16	51.57

The breaking load of steel wires of a certain diameter was measured and the results are given in table 4b. The data may be assumed to have a normal distribution with unknown mean and variance.

- (i) Obtain the best estimate for the mean and standard deviation for the breaking load.

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- (ii) Obtain the range of values for the mean and variance at 95% confidence level. The statistical tables provided may be used.

Table 4b Tensile strength measurements on steel wire

<i>Specimen</i>	<i>Strength (Kg)</i>
1	48.89
2	52.07
3	49.29
4	51.66
5	52.16
6	49.72
7	48.00
8	49.96
9	49.20
10	48.10
11	47.90
12	46.94
13	51.76
14	50.75
15	49.86
16	51.57

(50 markah)

...10/-

5. (a) Kekerasan komponen-komponen besi tuangan daripada dua pembekal diberikan di dalam Jadual 5a. Uji hipotesis yang menyatakan bahawa kedua-dua pembekal berkenaan mempunyai min kekerasan yang sama pada paras keyakinan 99%. Sisihan piawai kedua-dua bekalan ini boleh dianggap tidak diketahui tetapi mempunyai nilai yang sama.

Jadual 5a: Ukuran kekerasan besi tuangan

Pembekal 1	Pembekal 2
89.5	89.5
90.0	91.5
91.0	91.0
91.5	89.0
92.5	91.5
91.0	92.0
89.0	92.0
89.5	90.5
91.0	90.0
92.0	91.0

- (a) *The hardness of cast iron components from two suppliers is given in table 5a. Test the hypothesis that the two suppliers have the same mean for hardness at the 99% confidence level. The standard deviations of the two supplies may be assumed to be unknown but equal.*

Table 5a Hardness Measurements on cast iron

Supplier 1	Supplier 2
89.5	89.5
90.0	91.5
91.0	91.0
91.5	89.0
92.5	91.5
91.0	92.0
89.0	92.0
89.5	90.5
91.0	90.0
92.0	91.0

(50 markah)

...11/-

- (b) Dalam proses pengetinan, tin yang diisi mempunyai berat nominal 1 kg. 25 sampel yang bersaiz $n = 4$ telah diambil setiap setengah jam proses. Keputusan untuk purata-purata dan julat-julat sampel diberikan di dalam Jadual 5b.

- (i) Adakah p masih dalam keadaan terkawal?
(ii) Bina carta-carta \bar{X} & R untuk proses ini.

Jadual 5b

No. Sampel	1	2	3	4	5	6	7	8	9	10
Purata Sampel (X)	1.003	1.007	1.005	1.005	0.988	0.988	1.001	0.999	1.004	0.992
Julat Sampel (W)	0.016	0.028	0.014	0.035	0.018	0.028	0.022	0.010	0.027	0.041
No. Sampel	11	12	13	14	15	16	17	18	19	20
Purata Sampel (X)	0.995	0.998	1.002	1.000	0.998	0.994	1.008	1.002	1.001	0.999
Julat Sampel (W)	0.020	0.016	0.009	0.005	0.025	0.008	0.024	0.002	0.018	0.008
No. Sampel	21	22	23	24	25					
Purata Sampel (X)	1.003	0.998	1.006	1.000	1.002					
Julat Sampel (W)	0.025	0.017	0.031	0.021	0.028					

...12/-

- (b) In a canning process the filled cans have a nominal weight of 1kg. 25 samples of size $n = 4$ were taken every half an hour from the process and the results of sample averages and ranges are given in table 5b.

- (i) Is the p under control?
(ii) Construct \bar{X} & R charts for the process.

Table 5b

Sample No.	1	2	3	4	5	6	7	8	9	10
Sample average (\bar{X})	1.003	1.007	1.005	1.005	0.988	0.988	1.001	0.999	1.004	0.992
Sample range (W)	0.016	0.028	0.014	0.035	0.018	0.028	0.022	0.010	0.027	0.041
Sample No.	11	12	13	14	15	16	17	18	19	20
Sample average (\bar{X})	0.995	0.998	1.002	1.000	0.998	0.994	1.008	1.002	1.001	0.999
Sample range (W)	0.020	0.016	0.009	0.005	0.025	0.008	0.024	0.002	0.018	0.008
Sample No.	21	22	23	24	25					
Sample average (\bar{X})	1.003	0.998	1.006	1.000	1.002					
Sample range (W)	0.025	0.017	0.031	0.021	0.028					

(50 markah)

...13/-

6. (a) Bilangan kecacatan tuangan pada permukaan atas yang rata untuk beberapa tuangan yang dihasilkan di sebuah foundri diberikan di dalam Jadual 6a. Bina suatu carta kawalan yang sesuai untuk proses ini.

Jadual 6a: Bilangan kecacatan-kecacatan permukaan

Bil. Tuangan	Luas Permukaan Meter Persegi (n_i)	Bil. Cacat (c_i)	Cacat Per Meter Persegi (c_i/n_i)
1	0.84	3	3.57
2	0.62	2	3.22
3	0.84	4	4.76
4	0.62	4	6.45
5	1.08	5	4.63
6	0.62	3	4.84
7	0.84	2	2.38
8	0.62	6	9.68
9	1.08	5	4.63
10	0.62	2	3.22
11	0.84	12	14.29
12	0.62	2	3.22
13	0.62	1	1.61
14	1.08	6	5.56
15	0.84	8	9.52
16	0.84	7	8.33
17	0.62	5	8.06
18	1.08	6	5.56
19	1.08	7	6.48
20	0.62	4	6.45
Total	16.02	94	

- (a) The number of casting defects on the flat top surfaces of some castings produces in a foundry are given below in table 6a. Construct a suitable control chart for the process.

Table 6a No. of surfaces defects

Casting No. (i)	Surface Area Square Meters (n_i)	Number of Blemishes (c_i)	Blemishes per Square Meter (c_i/n_i)
1	0.84	3	3.57
2	0.62	2	3.22
3	0.84	4	4.76
4	0.62	4	6.45
5	1.08	5	4.63
6	0.62	3	4.84
7	0.84	2	2.38
8	0.62	6	9.68
9	1.08	5	4.63
10	0.62	2	3.22
11	0.84	12	14.29
12	0.62	2	3.22
13	0.62	1	1.61
14	1.08	6	5.56
15	0.84	8	9.52
16	0.84	7	8.33
17	0.62	5	8.06
18	1.08	6	5.56
19	1.08	7	6.48
20	0.62	4	6.45
Total	16.02	94	

(50 markah)

- (b) (i) Bincangkan makna dan kepentingan indeks-indeks keupayaan proses Cp dan Cpk.
- (ii) Tuliskan nota ringkas berkenaan carta Cusum.
- (iii) Bincangkan berkenaan kesalahan Jenis I dan Jenis II serta kaitannya dalam menghuraikan carta-carta kawalan.

...15/-

- (i) *Discuss the meaning and importance of the process capability indices C_p and C_{pk} .*
- (ii) *Write a short note on Cusum charts.*
- (iii) *Discuss Type I and Type II errors and their relevance in interpreting control charts.*

(50 markah)

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TABLE 11.12 Master Table for Normal Inspection—Single Sampling

Sample Size Code Letter	Sample Size	Acceptable Quality Levels (Normal Inspection)																													
		0.010	0.015	0.025	0.040	0.065	0.10	0.15	0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5	10	15	25	40	65	100	150	250	400	650	1000				
		Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	
A	2	↓	↓																												
B	3																														
C	5																														
D	8																														
E	13																														
F	20																														
G	32																														
H	50																														
I	80																														
K	125																														
L	200																														
M	315																														
N	500																														
P	800																														
Q	1250																														
R	2000																														

- ↓ = Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, do 100 percent inspection.
 ↑ = Use first sampling plan above arrow.
 Ac = Acceptance number.
 Re = Rejection number.

TABLE 11.13 Master Table for Tightened Inspection—Single Sampling

Sample Size Code Letter	Sample Size	Acceptable Quality Levels (tightened inspection)																													
		0.010	0.015	0.025	0.040	0.065	0.10	0.15	0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5	10	15	25	40	65	100	150	250	400	650	1000				
		Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re			
A	2																														
B	3																														
C	5																														
D	8																														
E	13																														
F	20																														
G	32																														
H	50																														
J	80																														
K	125																														
L	200																														
M	315																														
N	500																														
P	800																														
Q	1250																														
R	2000																														
S	3150																														

- ↓ = Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, do 100 percent inspection.
 ↑ = Use first sampling plan above arrow.
 Ac = Acceptance number.
 Re = Rejection number.

TABLE 11.14 Master Table for Reduced Inspection—Single Sampling

Sample Size Code Letter	Sample Size	Acceptable Quality Levels (Reduced Inspection) ¹																													
		0.010	0.015	0.025	0.040	0.065	0.10	0.15	0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5	10	15	25	40	65	100	150	250	400	650	1000				
		Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	
A	2	↓	↓																												
B	3	↓	↓																												
C	5	↓	↓																												
D	8	↓	↓																												
E	13	↓	↓																												
F	20	↓	↓																												
G	32	↓	↓																												
H	50	↓	↓																												
I	80	↓	↓																												
K	125	↓	↓																												
L	200	↓	↓																												
M	315	↓	↓																												
N	500	↓	↓																												
P	800	↓	↓																												
Q	1250	↓	↓																												
R	2000	↓	↓																												

- ↓ = Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, do 100 percent inspection.
 ↑ = Use first sampling plan above arrow.
 Ac = Acceptance number.
 Re = Rejection number.
 † = If the acceptance number has been exceeded, but the rejection number has not been reached, accept the lot, but institute normal inspection.

TABLE 11.11 Sample Size Code Letters

<i>Lot or Batch Size</i>			<i>Special Inspection Levels</i>				<i>General Inspection Levels</i>		
			<i>S-1</i>	<i>S-2</i>	<i>S-3</i>	<i>S-4</i>	<i>I</i>	<i>II</i>	<i>II</i>
2	to	8	A	A	A	A	A	A	B
9	to	15	A	A	A	A	A	B	C
16	to	25	A	A	B	B	B	C	D
26	to	50	A	B	B	C	C	D	E
51	to	90	B	B	C	C	C	E	F
91	to	150	B	B	C	D	D	F	G
151	to	280	B	C	D	E	E	G	H
281	to	500	B	C	D	E	F	H	J
501	to	1,200	C	C	E	F	G	J	K
1,201	to	3,200	C	D	E	G	H	K	L
3,201	to	10,000	C	D	F	G	J	L	M
10,001	to	35,000	C	D	F	H	K	M	N
35,001	to	150,000	D	E	G	J	L	N	P
150,001	to	500,000	D	E	G	J	M	P	Q
500,001	and	over	D	E	H	K	N	Q	R

TABLE 11.15 Master Table for Normal Inspection—Double Sampling

[illegible]

- ▼ Use first sampling plan below arrow. If sample size equals or exceeds lot or batch size, do 100 percent inspection.
- ▲ The first sampling plan above arrow.
- Ac Acceptance number
- Re Rejection number
- Use corresponding single sampling plan (or alternatively, use double sampling plan below, where available).

TABLE 11.16 Master Table for Tightened Inspection—Double Sampling

[illegible]

- ▼ = Use first sampling plan below arrow. If sample size equals or exceeds lot or batch size, do 100 percent inspection.
▲ = Use first sampling plan above arrow.
Ac = Acceptance number.
Re = Rejection number.
* = Use the corresponding single sampling plan (or alternatively, use double sampling plan below, where available).

TABLE 11.17 Master Table for Reduced Inspection—Double Sampling

Sample Size Code Letter	Sample Size	Sample Size	Cumulative Sample Size	Acceptable Quality Levels (Reduced Inspection) ¹																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
				0.010		0.015		0.025		0.040		0.065		0.10		0.15		0.25		0.40		0.65		1.0		1.5		2.5		4.0		6.5		10		15		25		40		65		100		150		250		400		650		1000																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
				Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re

* Use first sampling plan below arrow. If sample size equals or exceeds lot or batch size, do 100 percent inspection.

* Use first sampling plan above arrow.

* Acceptance number.

* Rejection number.

* Use corresponding single sampling plan for alternatively, use double sampling plan below, when available.

* If, after the second sample, the acceptance number has been exceeded, but the rejection number has not been reached, accept the lot, but reinstate normal inspection.

TABLE 11.21 Limit Numbers for Reduced Inspection

Number of Sample Units from Last 10 Lots or Batches	Acceptable Quality Level																												
	0.010	0.015	0.025	0.040	0.065	0.10	0.15	0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5	10	15	25	40	65	100	150	250	400	650	1000	1500	2500	
20-29	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	0	2	4	8	14	22	40	68	110	181	301	490	791
30-49	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	1	3	7	13	22	36	63	105	177	301	490	791	1264
50-79	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	2	3	7	14	25	40	63	110	181	301	490	791	1264	2000
80-129	*	*	*	*	*	*	*	*	*	*	*	*	0	0	2	4	7	14	24	42	68	105	181	301	490	791	1264	2000	3162
130-199	*	*	*	*	*	*	*	*	*	*	*	0	0	2	4	7	13	25	42	72	115	177	301	490	791	1264	2000	3162	5012
200-319	*	*	*	*	*	*	*	*	*	*	0	0	2	4	8	14	22	40	68	115	181	277	471	791	1264	2000	3162	5012	7746
320-499	*	*	*	*	*	*	*	*	*	0	0	1	4	8	14	24	39	68	113	189									
500-799	*	*	*	*	*	*	*	*	0	0	2	3	7	14	25	40	63	110	181										
800-1249	*	*	*	*	*	*	*	0	0	2	4	7	14	24	42	68	105	181											
1,250-1,999	*	*	*	*	*	*	0	0	2	4	7	13	24	40	69	110	169												
2,000-3,149	*	*	*	*	*	0	0	2	4	8	14	22	40	68	115	181													
3,150-4,999	*	*	*	*	0	0	1	4	8	14	24	38	67	111	186														
5,000-7,999	*	*	*	0	0	2	3	7	14	25	40	63	110	181															
8,000-12,499	*	*	0	0	2	4	7	14	24	42	68	105	181																
12,500-19,999	*	0	0	2	4	7	13	24	40	69	110	169																	
20,000-31,499	0	0	2	4	8	14	22	40	68	115	181																		
31,500-49,999	0	1	4	8	14	24	38	67	111	186																			
50,000 & Over	2	3	7	14	25	40	63	110	181	301																			

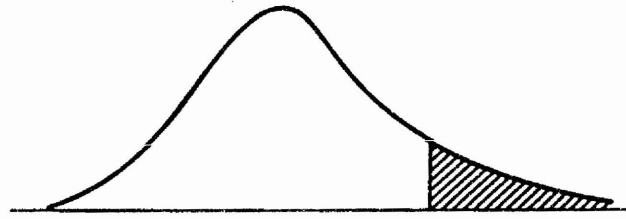
* Denotes that the number of sample units from the last 10 lots or batches is not sufficient for reduced inspection for this AQL. In this instance more than 10 lots or batches may be used for the calculation, provided that the lots or batches used are the most recent ones in sequence, that they have been on normal inspection, and that none has been rejected while on original inspection.

[illegible]

◆ = Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, do 100 percent inspection.
 ◆ = Use first sampling plan above arrow (refer to preceding page when necessary).
 Ac = Acceptance number.
 * = Use corresponding single sampling plan t or alternatively, use multiple sampling plan below, where available.
 Re = Rejection number.
 # = Acceptance not permitted at this sample size.
 () = If acceptance number has been exceeded, but the rejection number has not been reached, accept the lot, but reinstate normal inspection.

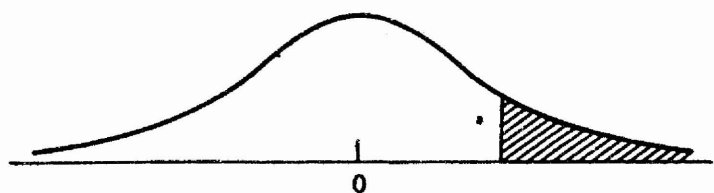
TABLE 11.19 Master Table for Tightened Inspection—Multiple Sampling

[illegible]

Percentage points of the χ^2 distribution*

ν	0.995	0.990	0.975	0.950	0.500	0.050	0.025	0.010	0.005
1	0.00+	0.00+	0.00+	0.00+	0.45	3.84	5.02	6.63	7.88
2	0.01	0.02	0.05	0.10	1.39	5.99	7.38	9.21	10.60
3	0.07	0.11	0.22	0.35	2.37	7.81	9.35	11.34	12.84
4	0.21	0.30	0.48	0.71	3.36	9.49	11.14	13.28	14.86
5	0.41	0.55	0.83	1.15	4.35	11.07	12.38	15.09	16.75
6	0.68	0.87	1.24	1.64	5.35	12.59	14.45	16.81	18.55
7	0.99	1.24	1.69	2.17	6.35	14.07	16.01	18.48	20.28
8	1.34	1.65	2.18	2.73	7.34	15.51	17.53	20.09	21.96
9	1.73	2.09	2.70	3.33	8.34	16.92	19.02	21.67	23.59
10	2.16	2.56	3.25	3.94	9.34	18.31	20.48	23.21	25.19
11	2.60	3.05	3.82	4.57	10.34	19.68	21.92	24.72	26.76
12	3.07	3.57	4.40	5.23	11.34	21.03	23.34	26.22	28.30
13	3.57	4.11	5.01	5.89	12.34	22.36	24.74	27.69	29.82
14	4.07	4.66	5.63	6.57	13.34	23.68	26.12	29.14	31.32
15	4.60	5.23	6.27	7.26	14.34	25.00	27.49	30.58	32.80
16	5.14	5.81	6.91	7.96	15.34	26.30	28.85	32.00	34.27
17	5.70	6.41	7.56	8.67	16.34	27.59	30.19	33.41	35.72
18	6.26	7.01	8.23	9.39	17.34	28.87	31.53	34.81	37.16
19	6.84	7.63	8.91	10.12	18.34	30.14	32.85	36.19	38.58
20	7.43	8.26	9.59	10.85	19.34	31.41	34.17	37.57	40.00
25	10.52	11.52	13.12	14.61	24.34	37.66	40.65	44.31	46.93
30	13.79	14.95	16.79	18.49	29.34	43.77	46.98	50.89	53.67
40	20.71	22.16	24.43	26.51	39.34	55.76	59.34	63.69	66.77
50	27.99	29.71	32.36	34.76	49.33	67.50	71.42	76.15	79.49
60	35.53	37.48	40.48	43.19	59.33	79.08	83.30	88.38	91.95
70	43.28	45.44	48.76	51.74	69.33	90.53	95.02	100.42	104.22
80	51.17	53.54	57.15	60.39	79.33	101.88	106.63	112.33	116.32
90	59.20	61.75	65.65	69.13	89.33	113.14	118.14	124.12	128.30
100	67.33	70.06	74.22	77.93	99.33	124.34	129.56	135.81	140.17

 ν = degrees of freedom.



α $v_1 \backslash v_2$	0.40	0.25	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
1	0.325	1.000	3.078	6.314	12.706	31.821	63.657	127.32	318.31	636.62
2	0.289	0.816	1.886	2.920	4.303	6.965	9.925	14.089	23.326	31.598
3	0.277	0.765	1.638	2.353	3.182	4.541	5.841	7.453	10.213	12.924
4	0.271	0.741	1.533	2.132	2.776	3.747	4.604	5.598	7.173	8.610
5	0.267	0.727	1.476	2.015	2.571	3.365	4.032	4.773	5.893	6.869
6	0.265	0.727	1.440	1.943	2.447	3.143	3.707	4.317	5.208	5.959
7	0.263	0.711	1.415	1.895	2.365	2.998	3.499	4.019	4.785	5.408
8	0.262	0.706	1.397	1.860	2.306	2.896	3.355	3.833	4.501	5.041
9	0.261	0.703	1.383	1.833	2.262	2.821	3.250	3.690	4.297	4.781
10	0.260	0.700	1.372	1.812	2.228	2.764	3.169	3.581	4.144	4.587
11	0.260	0.697	1.363	1.796	2.201	2.718	3.106	3.497	4.025	4.437
12	0.259	0.695	1.356	1.782	2.179	2.681	3.055	3.428	3.930	4.318
13	0.259	0.694	1.350	1.771	2.160	2.650	3.012	3.372	3.852	4.221
14	0.258	0.692	1.345	1.761	2.145	2.624	2.977	3.326	3.787	4.140
15	0.258	0.691	1.341	1.753	2.131	2.602	2.947	3.286	3.733	4.073
16	0.258	0.690	1.337	1.746	2.120	2.583	2.921	3.252	3.686	4.015
17	0.257	0.689	1.333	1.740	2.110	2.567	2.898	3.222	3.646	3.965
18	0.257	0.688	1.330	1.734	2.101	2.552	2.878	3.197	3.610	3.922
19	0.257	0.688	1.328	1.729	2.093	2.539	2.861	3.174	3.579	3.883
20	0.257	0.687	1.325	1.725	2.086	2.528	2.845	3.153	3.552	3.850
21	0.257	0.686	1.323	1.721	2.080	2.518	2.831	3.135	3.527	3.819
22	0.256	0.686	1.321	1.717	2.074	2.508	2.819	3.119	3.505	3.792
23	0.256	0.685	1.319	1.714	2.069	2.500	2.807	3.104	3.485	3.767
24	0.256	0.685	1.318	1.711	2.064	2.492	2.797	3.091	3.467	3.745
25	0.256	0.684	1.316	1.708	2.060	2.485	2.787	3.078	3.450	3.725
26	0.256	0.684	1.315	1.706	2.056	2.479	2.779	3.067	3.435	3.707
27	0.256	0.684	1.314	1.703	2.052	2.473	2.771	3.057	3.421	3.690
28	0.256	0.683	1.313	1.701	2.048	2.467	2.763	3.047	3.408	3.674
29	0.256	0.683	1.311	1.699	2.045	2.462	2.756	3.038	3.396	3.659
30	0.256	0.683	1.310	1.697	2.042	2.457	2.750	3.030	3.385	3.646
40	0.255	0.681	1.303	1.684	2.021	2.423	2.704	2.971	3.307	3.551
60	0.254	0.679	1.296	1.671	2.000	2.390	2.660	2.915	3.232	3.460
120	0.254	0.677	1.289	1.658	1.980	2.358	2.617	2.860	3.160	3.373
∞	0.253	0.674	1.282	1.645	1.960	2.326	2.576	2.807	3.090	3.291

^a v = degrees of freedom.

POISSON DISTRIBUTION

$c \backslash np_0$	2.1	2.2	2.3	2.4	2.5
0	0.123 (0.123)	0.111 (0.111)	0.100 (0.100)	0.091 (0.091)	0.082 (0.082)
1	0.257 (0.380)	0.244 (0.355)	0.231 (0.331)	0.218 (0.309)	0.205 (0.287)
2	0.270 (0.650)	0.268 (0.623)	0.265 (0.596)	0.261 (0.570)	0.256 (0.543)
3	0.189 (0.839)	0.197 (0.820)	0.203 (0.799)	0.209 (0.779)	0.214 (0.757)
4	0.099 (0.938)	0.108 (0.928)	0.117 (0.916)	0.125 (0.904)	0.134 (0.891)
5	0.042 (0.980)	0.048 (0.976)	0.054 (0.970)	0.060 (0.964)	0.067 (0.958)
6	0.015 (0.995)	0.017 (0.993)	0.021 (0.991)	0.024 (0.988)	0.028 (0.986)
7	0.004 (0.999)	0.005 (0.998)	0.007 (0.998)	0.008 (0.996)	0.010 (0.996)
8	0.001 (1.000)	0.002 (1.000)	0.002 (1.000)	0.003 (0.999)	0.003 (0.999)
9				0.001 (1.000)	0.001 (1.000)

$c \backslash np_0$	2.6	2.7	2.8	2.9	3.0
0	0.074 (0.074)	0.067 (0.067)	0.061 (0.061)	0.055 (0.055)	0.050 (0.050)
1	0.193 (0.267)	0.182 (0.249)	0.170 (0.231)	0.160 (0.215)	0.149 (0.199)
2	0.251 (0.518)	0.245 (0.494)	0.238 (0.469)	0.231 (0.446)	0.224 (0.423)
3	0.218 (0.736)	0.221 (0.715)	0.223 (0.692)	0.224 (0.670)	0.224 (0.647)
4	0.141 (0.877)	0.149 (0.864)	0.156 (0.848)	0.162 (0.832)	0.168 (0.815)
5	0.074 (0.951)	0.080 (0.944)	0.087 (0.935)	0.094 (0.926)	0.101 (0.916)
6	0.032 (0.983)	0.036 (0.980)	0.041 (0.976)	0.045 (0.971)	0.050 (0.966)
7	0.012 (0.995)	0.014 (0.994)	0.016 (0.992)	0.019 (0.990)	0.022 (0.988)
8	0.004 (0.999)	0.005 (0.999)	0.006 (0.998)	0.007 (0.997)	0.008 (0.996)
9	0.001 (1.000)	0.001 (1.000)	0.002 (1.000)	0.002 (0.999)	0.003 (0.999)
10				0.001 (1.000)	0.001 (1.000)

$c \backslash np_0$	3.1	3.2	3.3	3.4	3.5
0	0.045 (0.045)	0.041 (0.041)	0.037 (0.037)	0.033 (0.033)	0.030 (0.030)
1	0.140 (0.185)	0.130 (0.171)	0.122 (0.159)	0.113 (0.146)	0.106 (0.136)
2	0.216 (0.401)	0.209 (0.380)	0.201 (0.360)	0.193 (0.339)	0.185 (0.321)
3	0.224 (0.625)	0.223 (0.603)	0.222 (0.582)	0.219 (0.558)	0.216 (0.537)
4	0.173 (0.798)	0.178 (0.781)	0.182 (0.764)	0.186 (0.744)	0.189 (0.726)
5	0.107 (0.905)	0.114 (0.895)	0.120 (0.884)	0.126 (0.870)	0.132 (0.858)
6	0.056 (0.961)	0.061 (0.956)	0.066 (0.950)	0.071 (0.941)	0.077 (0.935)
7	0.025 (0.986)	0.028 (0.984)	0.031 (0.981)	0.035 (0.976)	0.038 (0.973)
8	0.010 (0.996)	0.011 (0.995)	0.012 (0.993)	0.015 (0.991)	0.017 (0.990)
9	0.003 (0.999)	0.004 (0.999)	0.005 (0.998)	0.006 (0.997)	0.007 (0.997)
10	0.001 (1.000)	0.001 (1.000)	0.002 (1.000)	0.002 (0.999)	0.002 (0.999)
11				0.001 (1.000)	0.001 (1.000)

$c \backslash np_0$	3.6	3.7	3.8	3.9	4.0
0	0.027 (0.027)	0.025 (0.025)	0.022 (0.022)	0.020 (0.020)	0.018 (0.018)
1	0.098 (0.125)	0.091 (0.116)	0.085 (0.107)	0.079 (0.099)	0.073 (0.091)
2	0.177 (0.302)	0.169 (0.285)	0.161 (0.268)	0.154 (0.253)	0.147 (0.238)
3	0.213 (0.515)	0.209 (0.494)	0.205 (0.473)	0.200 (0.453)	0.195 (0.433)
4	0.191 (0.706)	0.193 (0.687)	0.194 (0.667)	0.195 (0.648)	0.195 (0.628)
5	0.138 (0.844)	0.143 (0.830)	0.148 (0.815)	0.152 (0.800)	0.157 (0.785)
6	0.083 (0.927)	0.088 (0.918)	0.094 (0.909)	0.099 (0.899)	0.104 (0.889)
7	0.042 (0.969)	0.047 (0.965)	0.051 (0.960)	0.055 (0.954)	0.060 (0.949)
8	0.019 (0.988)	0.022 (0.987)	0.024 (0.984)	0.027 (0.981)	0.030 (0.979)
9	0.008 (0.996)	0.009 (0.996)	0.010 (0.994)	0.012 (0.993)	0.013 (0.992)
10	0.003 (0.999)	0.003 (0.999)	0.004 (0.998)	0.004 (0.997)	0.005 (0.997)
11	0.001 (1.000)	0.001 (1.000)	0.001 (0.999)	0.002 (0.999)	0.002 (0.999)
12			0.001 (1.000)	0.001 (1.000)	0.001 (1.000)

Factors for Computing Central Lines and 3σ Control Limits for \bar{X} , s , and R Charts

OBSERVATIONS IN SAMPLE, n	CHART FOR AVERAGES			CHART FOR STANDARD DEVIATIONS					CHART FOR RANGES					
	FACTORS FOR CONTROL LIMITS			FACTOR FOR CENTRAL LINE	FACTORS FOR CONTROL LIMITS				FACTOR FOR CENTRAL LINE	FACTORS FOR CONTROL LIMITS				
	A	A_2	A_3	c_4	B_3	B_4	B_5	B_6	d_2	d_1	D_1	D_2	D_3	D_4
2	2.121	1.880	2.659	0.7979	0	3.267	0	2.606	1.128	0.853	0	3.686	0	3.267
3	1.732	1.023	1.954	0.8862	0	2.568	0	2.276	1.693	0.888	0	4.358	0	2.574
4	1.500	0.729	1.628	0.9213	0	2.266	0	2.088	2.059	0.880	0	4.698	0	2.282
5	1.342	0.577	1.427	0.9400	0	2.089	0	1.964	2.326	0.864	0	4.918	0	2.114
6	1.225	0.483	1.287	0.9515	0.030	1.970	0.029	1.874	2.534	0.848	0	5.078	0	2.004
7	1.134	0.419	1.182	0.9594	0.118	1.882	0.113	1.806	2.704	0.833	0.204	5.204	0.076	1.924
8	1.061	0.373	1.099	0.9650	0.185	1.815	0.179	1.751	2.847	0.820	0.388	5.306	0.136	1.864
9	1.000	0.337	1.032	0.9693	0.239	1.761	0.232	1.707	2.970	0.808	0.547	5.393	0.184	1.816
10	0.949	0.308	0.975	0.9727	0.284	1.716	0.276	1.669	3.078	0.797	0.687	5.469	0.223	1.777
11	0.905	0.285	0.927	0.9754	0.321	1.679	0.313	1.637	3.173	0.787	0.811	5.535	0.256	1.744
12	0.866	0.266	0.886	0.9776	0.354	1.646	0.346	1.610	3.258	0.778	0.922	5.594	0.283	1.717
13	0.832	0.249	0.850	0.9794	0.382	1.618	0.374	1.585	3.336	0.770	1.025	5.647	0.307	1.693
14	0.802	0.235	0.817	0.9810	0.406	1.594	0.399	1.563	3.407	0.763	1.118	5.696	0.328	1.672
15	0.775	0.223	0.789	0.9823	0.428	1.572	0.421	1.544	3.472	0.756	1.203	5.741	0.347	1.653
16	0.750	0.212	0.763	0.9835	0.448	1.552	0.440	1.526	3.532	0.750	1.282	5.782	0.363	1.637
17	0.728	0.203	0.739	0.9845	0.466	1.534	0.458	1.511	3.588	0.744	1.356	5.820	0.378	1.622
18	0.707	0.194	0.718	0.9854	0.482	1.518	0.475	1.496	3.640	0.739	1.424	5.856	0.391	1.608
19	0.688	0.187	0.698	0.9862	0.497	1.503	0.490	1.483	3.689	0.734	1.487	5.891	0.403	1.597
20	0.671	0.180	0.680	0.9869	0.510	1.490	0.504	1.470	3.735	0.729	1.549	5.921	0.415	1.585

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